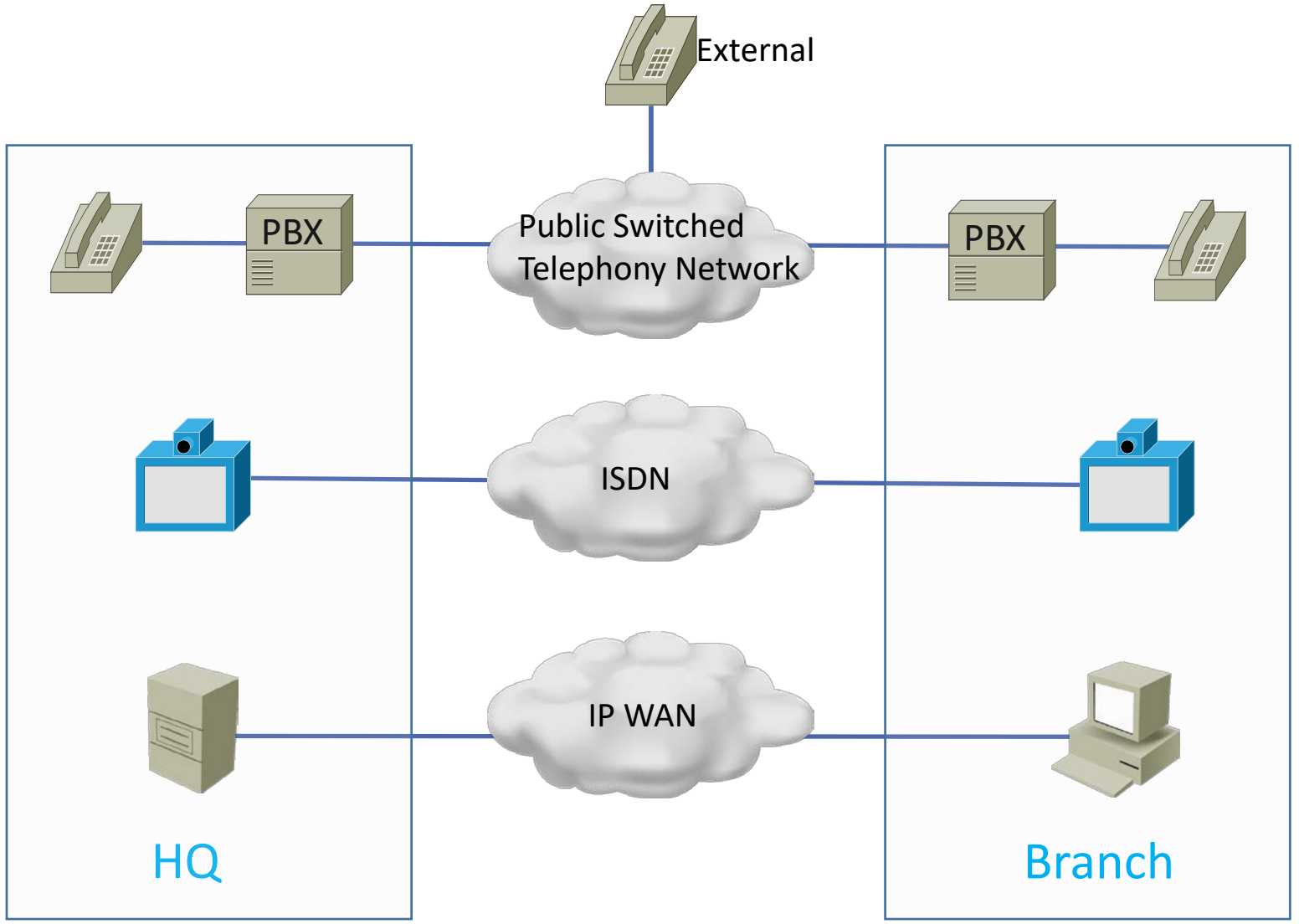
Dedicated Voice, Video and Data Networks



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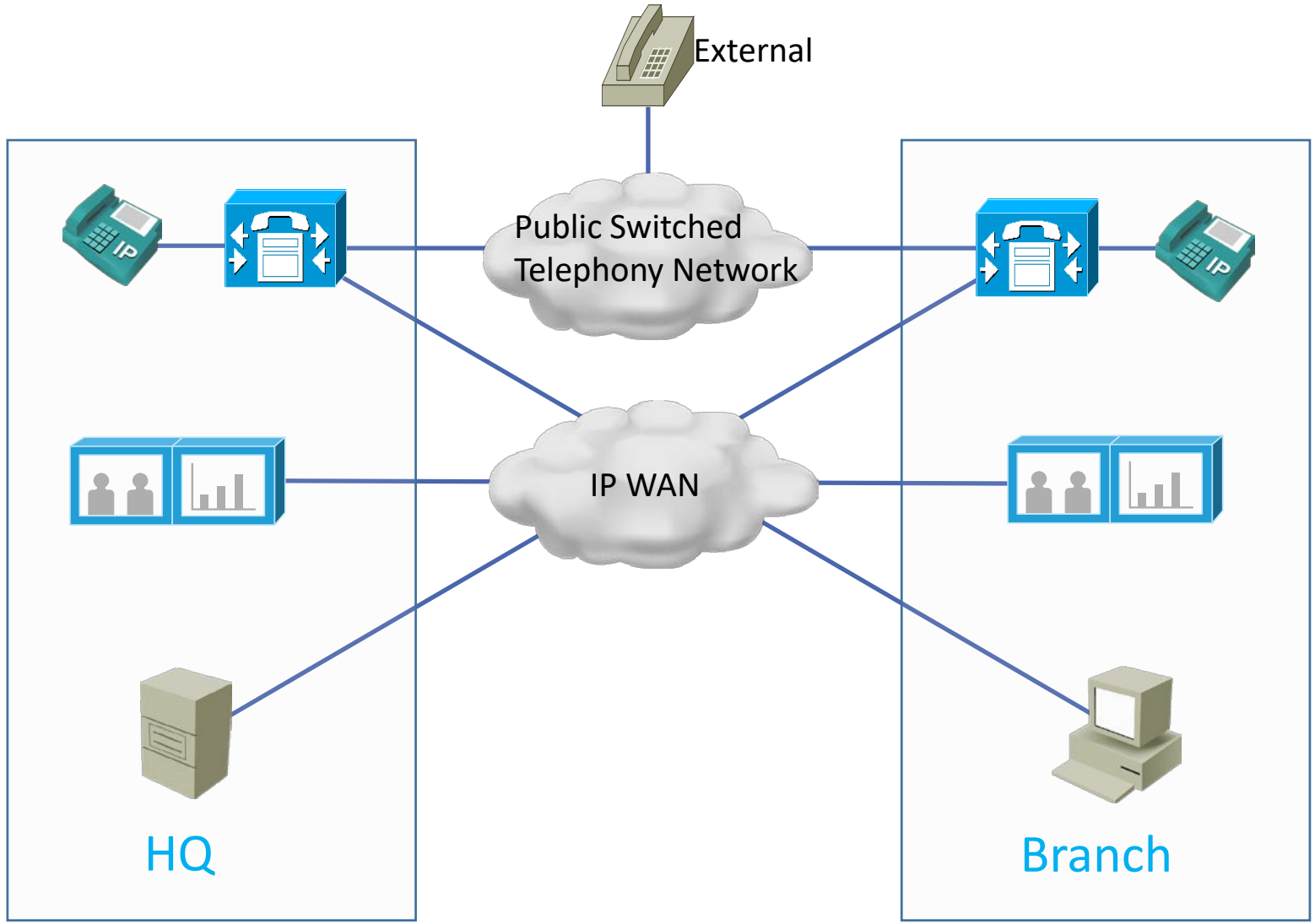
Converged Networks



Traditional vs Converged Networks

- On old traditional networks, data, voice and video had their own separate network infrastructure and did not impact each other
- On modern networks, data, voice and video run over the same shared infrastructure
- This enables cost savings and advanced features for voice and video
- Data, voice and video are all fighting for the same shared bandwidth

Quality Requirements for Voice and Video

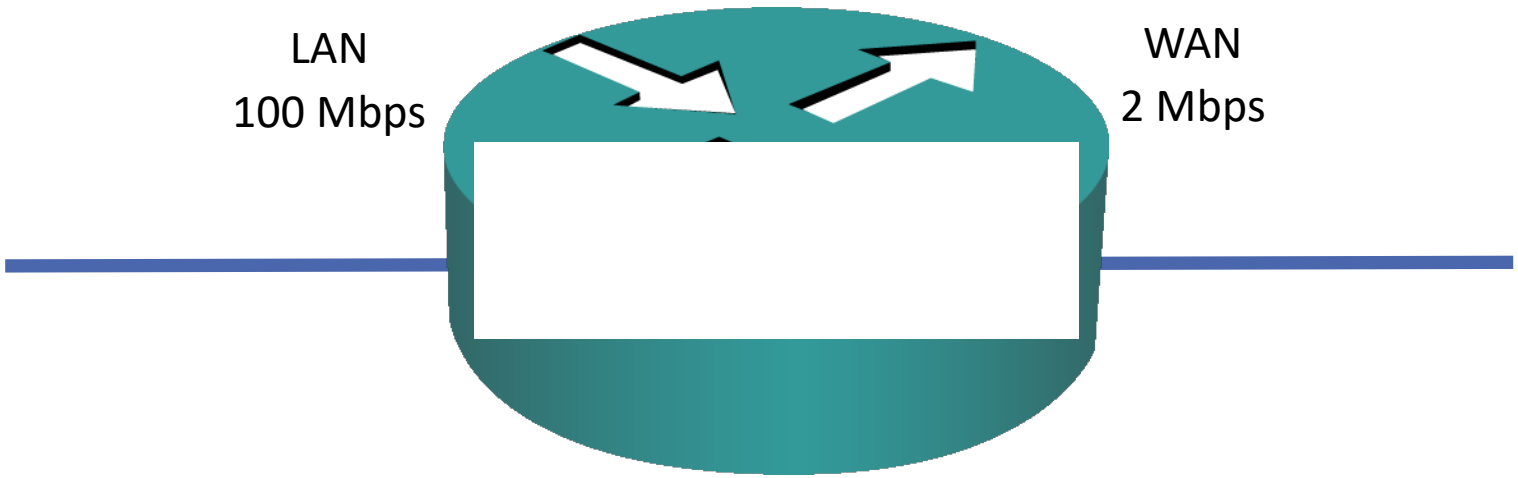
- Voice and traditional standard definition video packets must meet these recommended requirements to be an acceptable quality call:
  - Latency (delay) ≤ 150 ms
  - Jitter (variation in delay) ≤ 30 ms
  - Loss ≤ 1%
- These are one way requirements, meaning a packet sent from a phone in HQ has 150ms to reach the phone in the branch, and vice versa
- HD video has stricter requirements

FIFO First In First Out

- Whenever congestion is experienced on a router or switch, packets are sent out in a First In First Out (FIFO) manner by default
- Congestion can be experienced whenever it is possible for packets to come in quicker than they can be sent out

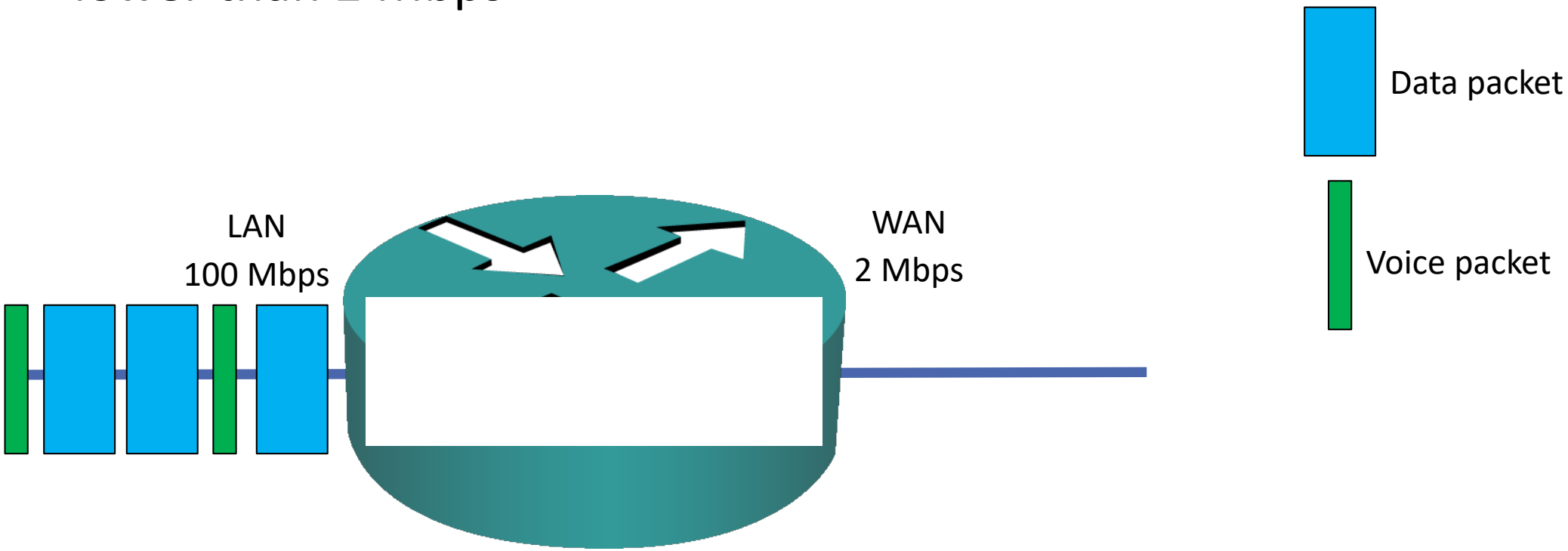
Congestion Example

- Traffic is going left to right from the HQ to the branch
- The WAN edge router has a FastEthernet interface on the inside LAN interface and an E1 interface on the outside WAN interface



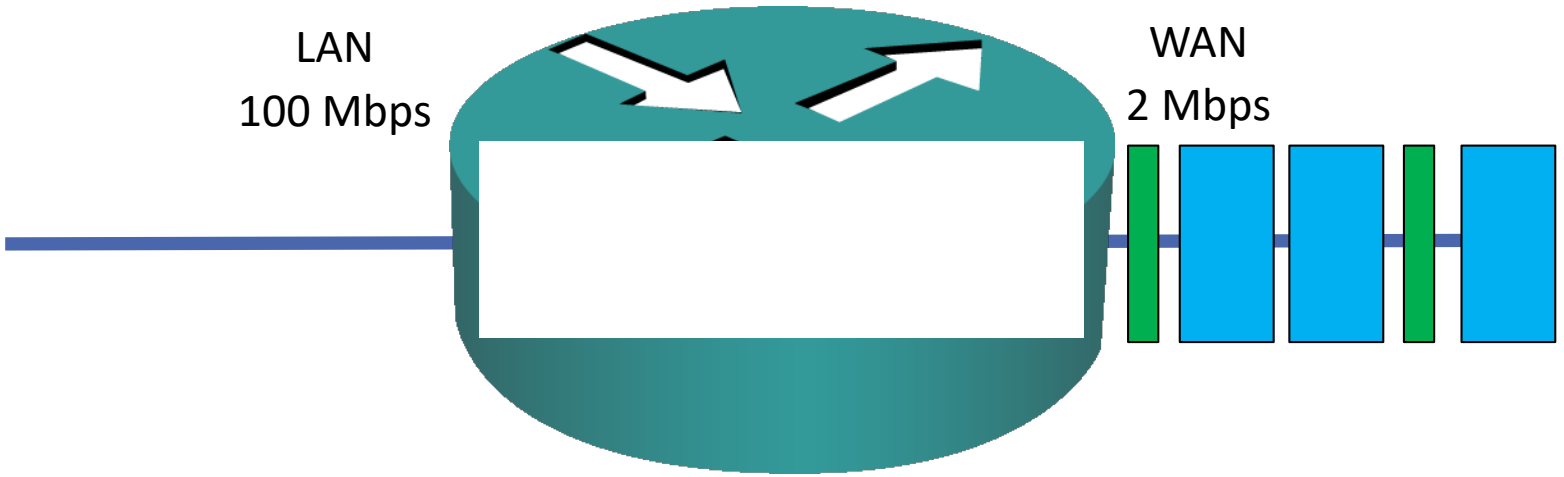
Congestion Example

- Traffic destined for the branch comes in on the LAN interface at a rate lower than 2 Mbps



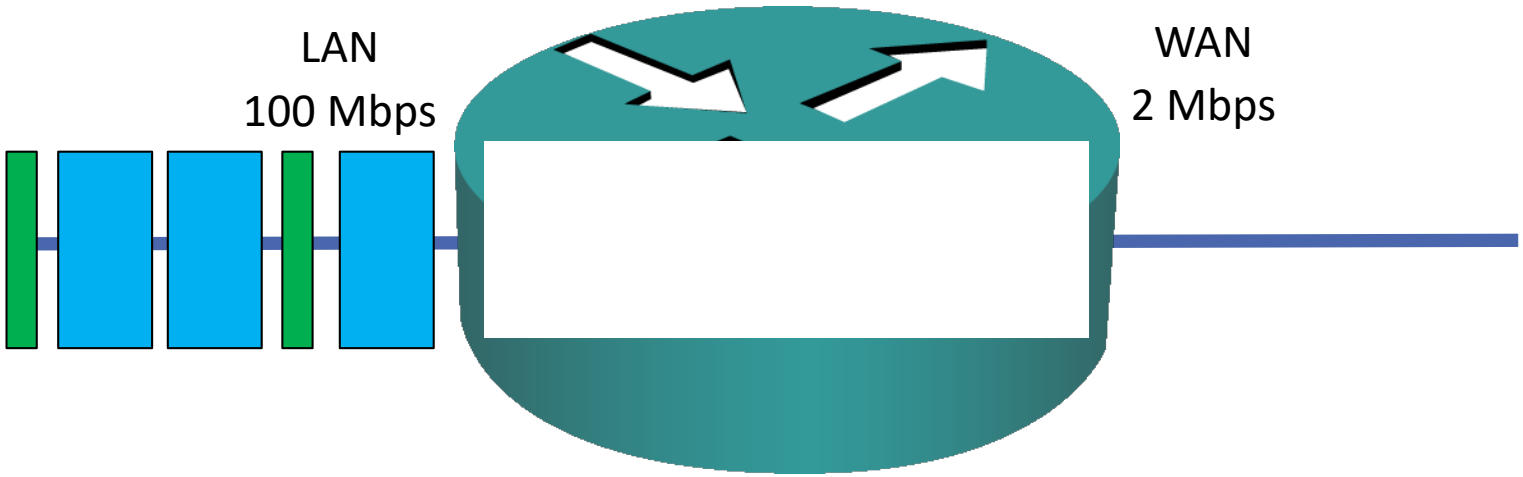
Congestion Example

- Packets can be sent out immediately as they arrive – there is no congestion



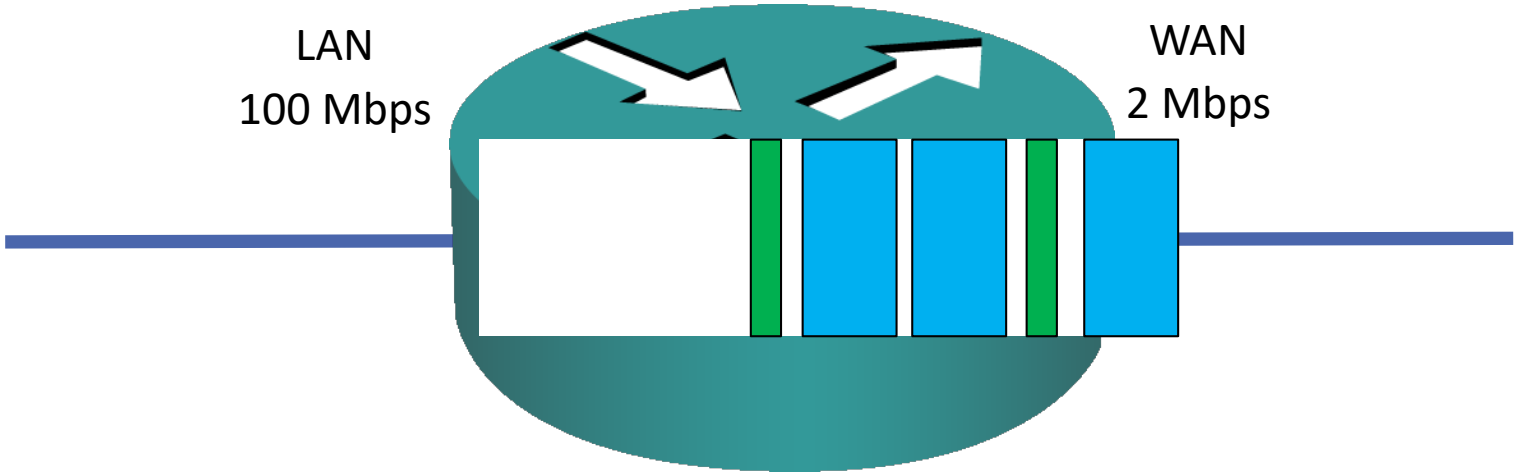
Congestion Example

- Traffic destined for the branch comes in on the LAN interface at a rate higher than 2 Mbps



Congestion Example

- Packets are arriving faster than they can be sent out
- Packets wait in the queue to go out
- Packets are sent out FIFO in the order they were received



Effects of Congestion

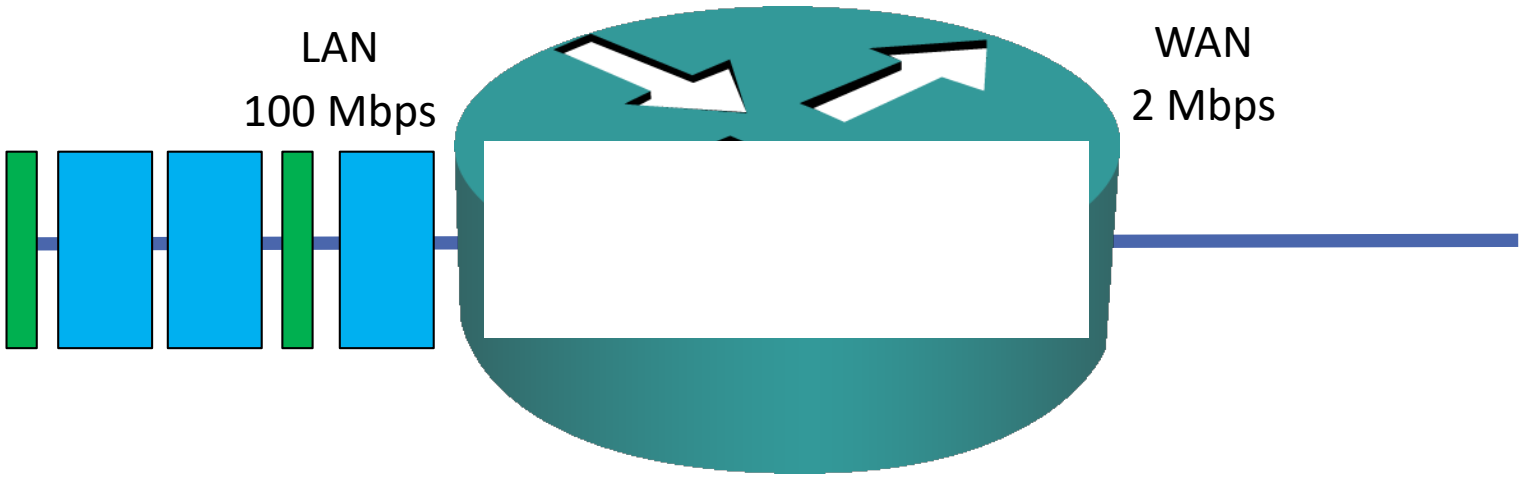
- Congestion causes delay to packets as they wait in the queue
- As the size of the queue changes it causes jitter
- There is a limit to the size of the queue. If a packet arrives when the queue is full the router will drop it
- Voice and video calls (and applications) will be unacceptable quality if they do not meet their delay, jitter and loss requirements

How to Mitigate Congestion

- Add more bandwidth (this costs money)
- Use Quality of Service techniques to give better service to the traffic which needs it

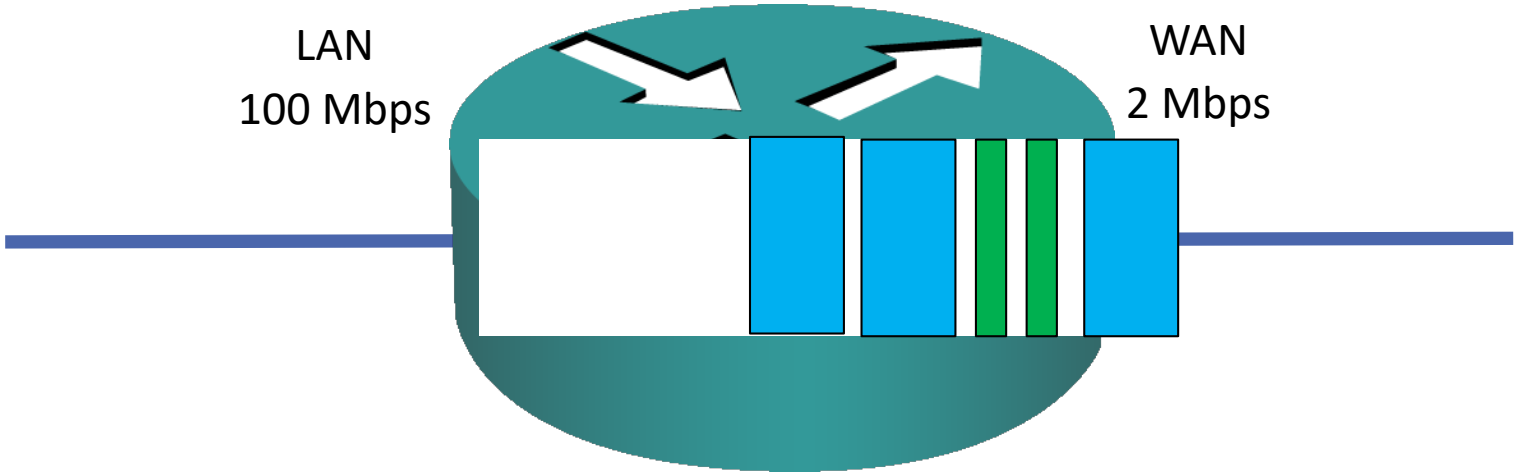
Congestion Example with QoS Queuing

- Traffic destined for the branch comes in on the LAN interface at a rate higher than 2 Mbps



Congestion Example

- Packets are arriving faster than they can be sent out
- Packets wait in the queue to go out
- The router recognises the voice packets and moves them to the front of the queue to minimise their delay



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Effects of QoS Queuing

- QoS queuing can reduce latency, jitter and loss for particular traffic
- The original driver for QoS was Voice over IP but it can also be used to give better service to data applications
- If you're giving one type of traffic better service on the same link you started with, the other traffic types must get worse service
- The point is to give each type of traffic the service it requires
- QoS queuing is not a magic bullet and is designed to mitigate temporary periods of congestion. If a link is permanently congested the bandwidth should be increased